



Australian Government

Department of Education, Employment and Workplace Relations

MSATCM510A Apply metallurgical principles and techniques in welding and other thermal processes

Release: 1

MSATCM510A Apply metallurgical principles and techniques in welding and other thermal processes

Modification History

Not applicable.

Unit Descriptor

Unit Descriptor	This unit covers applying metallurgical principles and techniques to welding applications
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Application of the Unit

Application of the unit	This unit requires application of scientific principles and techniques as a member of a design and development team or similar in support of the design and development of welding and other thermal practices in mechanical and manufacturing applications.
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Licensing/Regulatory Information

Not applicable.

Pre-Requisites

Pre-requisite Units	<i>MSATCM505A</i>	<i>Select metal joining process</i>

Employability Skills Information

Employability Skills	This unit contains employability skills.
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Elements and Performance Criteria Pre-Content

Not applicable.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Select welding or thermal process principles and techniques relevant to particular applications	1.1. Consultations and briefings are undertaken with managers, employers and customers and other sources of information researched as appropriate to determine welding application requiring metallurgical specification and analysis 1.2. Relevant welding and thermal cutting techniques, principles and associated technologies are selected for application
2. Undertake welding and thermal process analysis and specify welding or other thermal process solutions	2.1. Relevant scientific principles are applied in a consistent and appropriate manner to obtain the required welding or thermal cutting solution. 2.2. Appropriate calculations and coherent units are used in the solution of engineering calculations. 2.3. Significant figures are used in engineering calculations. 2.4. Relevant techniques and associated technologies, software and hardware are applied in a consistent and appropriate manner to obtain the required welding or thermal process solutions. 2.5. Analysis results are reported and welding or thermal process solution recommended

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This describes the essential skills and knowledge and their level, required for this unit.

Required skills:

- Select appropriate scientific principles to suit specific welding applications
- Select appropriate basic mechanical techniques and associated technologies, software and hardware to suit specific applications in welding
- Apply and manipulate appropriate formulas for applications involving engineering calculations
- Apply appropriate calculations to engineering situations
- Refer solutions to the original aim of the welding application
- Quote solutions in appropriate units, using appropriate significant figures
- Quote limitations of solutions, due to assumptions, scientific principles and techniques used
- Present solutions referring to the original aim of the application.

Required knowledge:

Competency includes sufficient knowledge of:

- Welding principles and processes as specified in the range statement, including mechanical, electrical chemical and metallurgical processes associated with welding
- Limitations of scientific principles associated with welding
- Other thermal processes including cutting , gouging, shaping etc.

Evidence Guide

EVIDENCE GUIDE

The Evidence Guide provides advice on assessment and must be read in conjunction with the Performance Criteria, Required Skills and Knowledge, the Range Statement and the Assessment Guidelines for the Training Package.

Overview of assessment	A person who demonstrates competency in this unit must be able to apply metallurgical principles and techniques in welding. Critical aspects for assessment and evidence are required to demonstrate competency in this unit.
Critical aspects for assessment and evidence required to demonstrate competency in this unit	It is essential that competence is demonstrated in the ability to: • select the most suitable technical and economic welding and other thermal processes for an application • present analysis results and recommendations that are relevant to the product or metallurgical situation
Relationship to other units	This unit may be assessed concurrently with other relevant units.
Assessment method and context	Assessors must be satisfied that the person can consistently perform the unit as a whole, as defined by the elements, performance criteria, skills and knowledge. A holistic approach should be taken to the assessment. Assessors should gather sufficient, fair, valid, reliable, authentic and current evidence from a range of sources. Sources of evidence may include direct observation, reports from supervisors, peers and colleagues, project work, samples, organisation records and questioning. Assessment should not require language, literacy or numeracy skills beyond those required for the unit. The assessee will have access to all techniques, procedures, information, resources and aids which would normally be available in the workplace. The method of assessment should be discussed and agreed with the assessee prior to the commencement of assessment.
Resource implications	This section should be read in conjunction with the range of variables for this unit of competency. Resources required include suitable access to an operating plant or equipment that allows for appropriate and realistic simulation. A bank of case studies/scenarios and questions will also be required to the extent that they form part of the assessment method. Questioning may take place either in the workplace, or in an adjacent, quiet facility such as an office or lunchroom. No other special resources are required.

Range Statement

RANGE STATEMENT

The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.

Codes of practice/standards	Where reference is made to industry codes of practice, and/or Australian/international standards, it is expected the latest version will be used.
Application	Application refers to any manufacturing, construction fabrication or maintenance process where welding or other thermal process is required and a metallurgical analysis and specification is required either before or after welding or other thermal process is undertaken.
Sources of information	• Reference standards and texts • Manufacturers catalogues and industrial magazines • Websites • Use of phone, email and fax for information gathering
Welding techniques and principles include	Weld defect description: • for C/Mn and low alloy steels. • shape defects: excess weld metal, overlap, undercut. • lack of fusion, penetration: incomplete root penetration, lack of root fusion, lack of interrune fusion, lack of side wall fusion. • inclusions: linear, isolated, oxides, . • gas porosity: worm hole, uniform, restart, surface. • solidification porosity: crater pipe, shrinkage porosity. • solidification cracking: hot cracking, lamellar tearing. • hydrogen heat affected zone cracking. • reheat cracking. • weldability of aluminium and its alloys: • inherent problems: hydrogen porosity, oxide, their prevention. • hot cracking: causes, alloys susceptible, alloys resistant, filler metals. • heat affected zone cracking . • welding age-hardened alloys. • welding work hardened alloys. • weldability of carbon and low steels: • the welding zones of steels: identification and microstructures, relation to the iron/iron carbide equilibrium diagram, multi-run welds.

RANGE STATEMENT	
	• hot cracking: carbon-manganese/sulphur ration. • cold cracking: effect of hydrogen, martensite, stress. • calculation of carbon equivalents • hydrogen content of steel welds and its control. • residual stress avoidance and removal. • calculation of weld preheat temperatures. • tests for cold crack susceptibility. • weldability of stainless steels • stainless steel types. • thermal and electrical conductivity. • thermal expansion. • schaeffler and delong diagrams to predict structures. • austenitic stainless steels: ferrite/hot cracking, corrosion, carbon content/intergranular corrosion.heat affected zone precipitation , carbide stabilisers, extra low carbon stainless. • other special grades: ferritic/ austenitic, martensitic/austenitic. • weldability of cast irons. • special techniques • weldability of the nickel alloys. • filler metals, braze welding
Other thermal processes include:	Cutting, gouging, shaping or local treatment using: • oxy /acetylene • oxy/hydrogen • plasma • carbon arc
Significant figures	Are those relevant to accuracy and are appropriate to the process, data and desired range of results

Unit Sector(s)

Unit Sector	Metallurgy
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Competency field

Competency Field	
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Co-requisite units

Co-requisite Units		